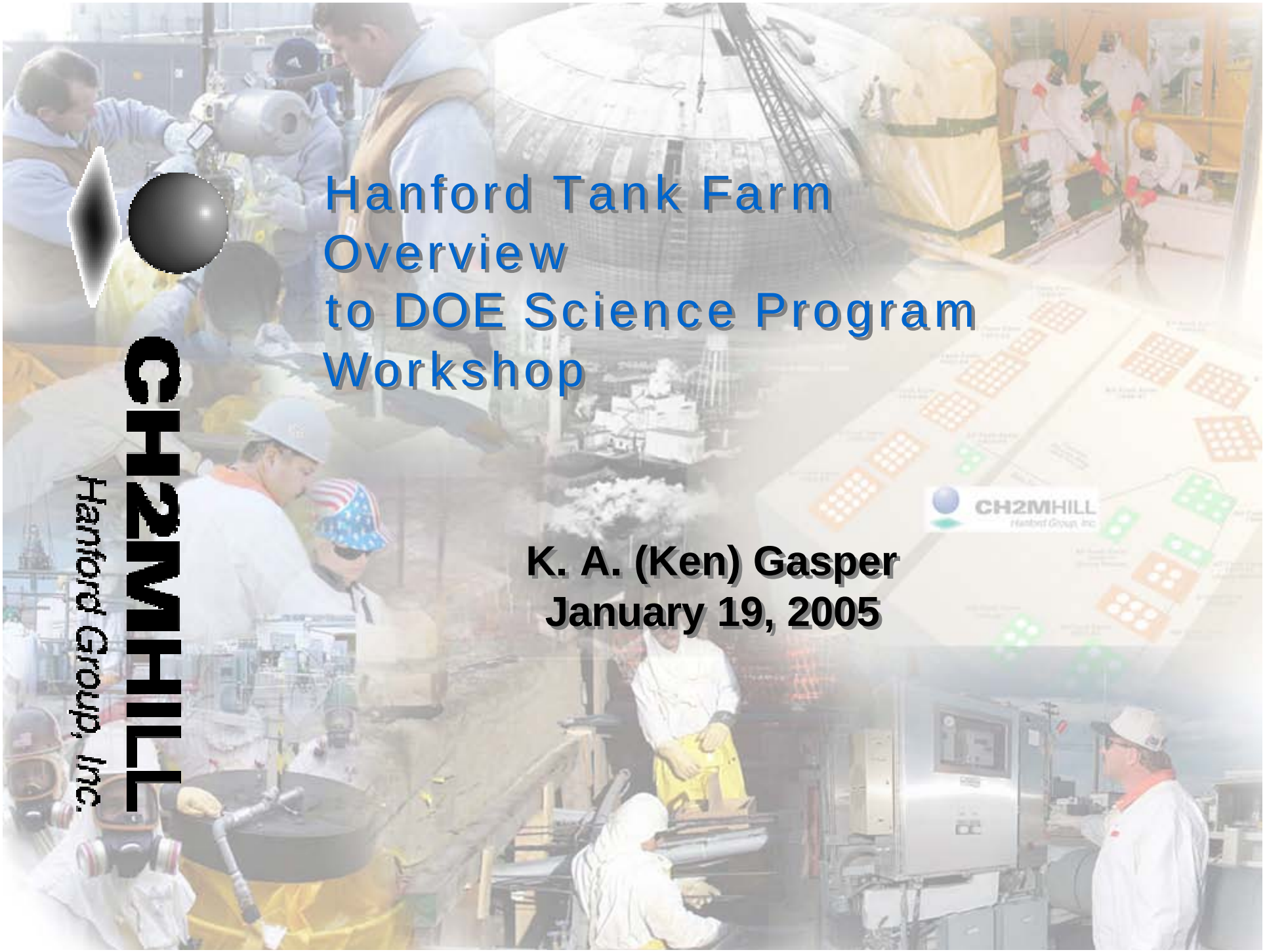


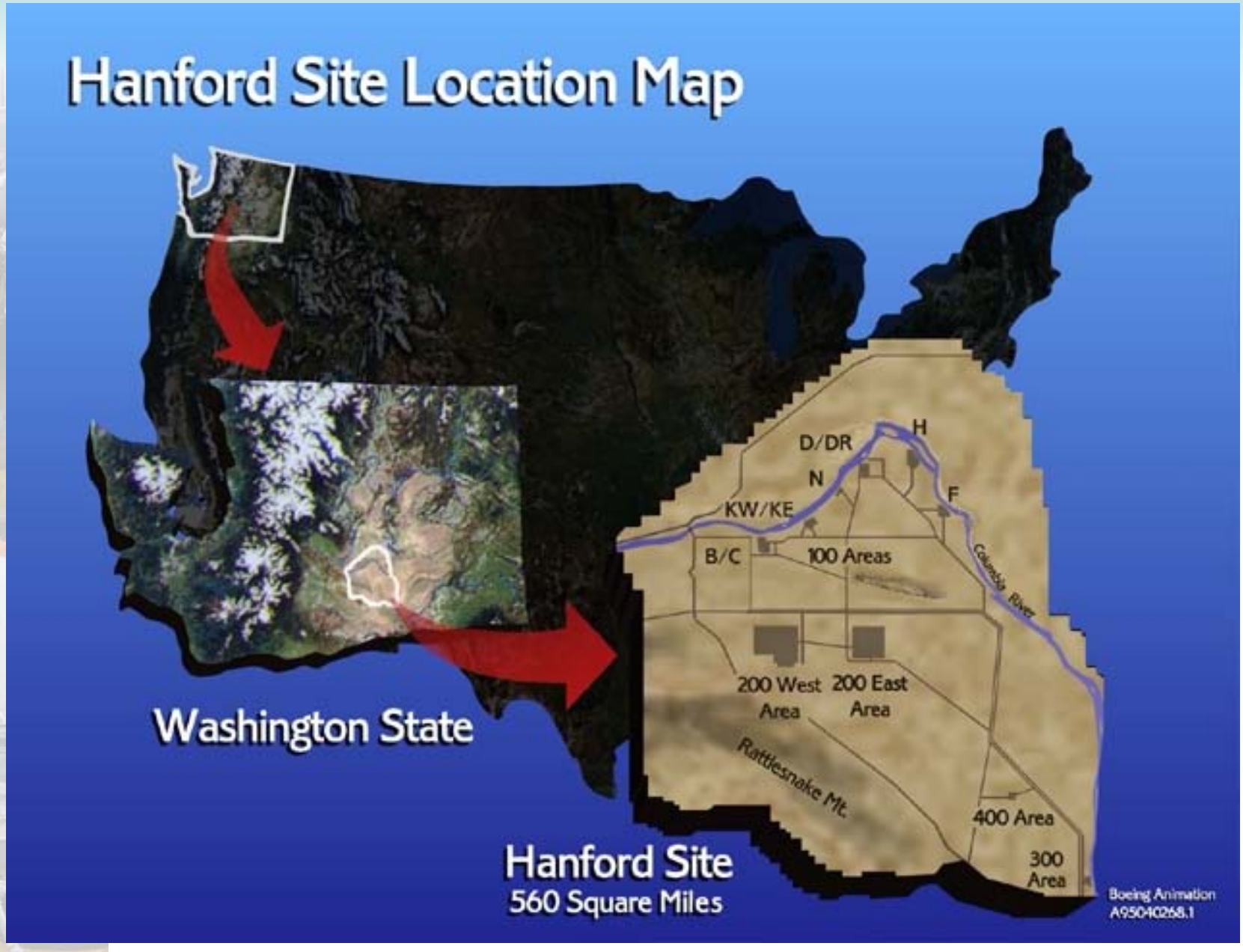
Hanford Tank Farm Overview to DOE Science Program Workshop

K. A. (Ken) Gasper

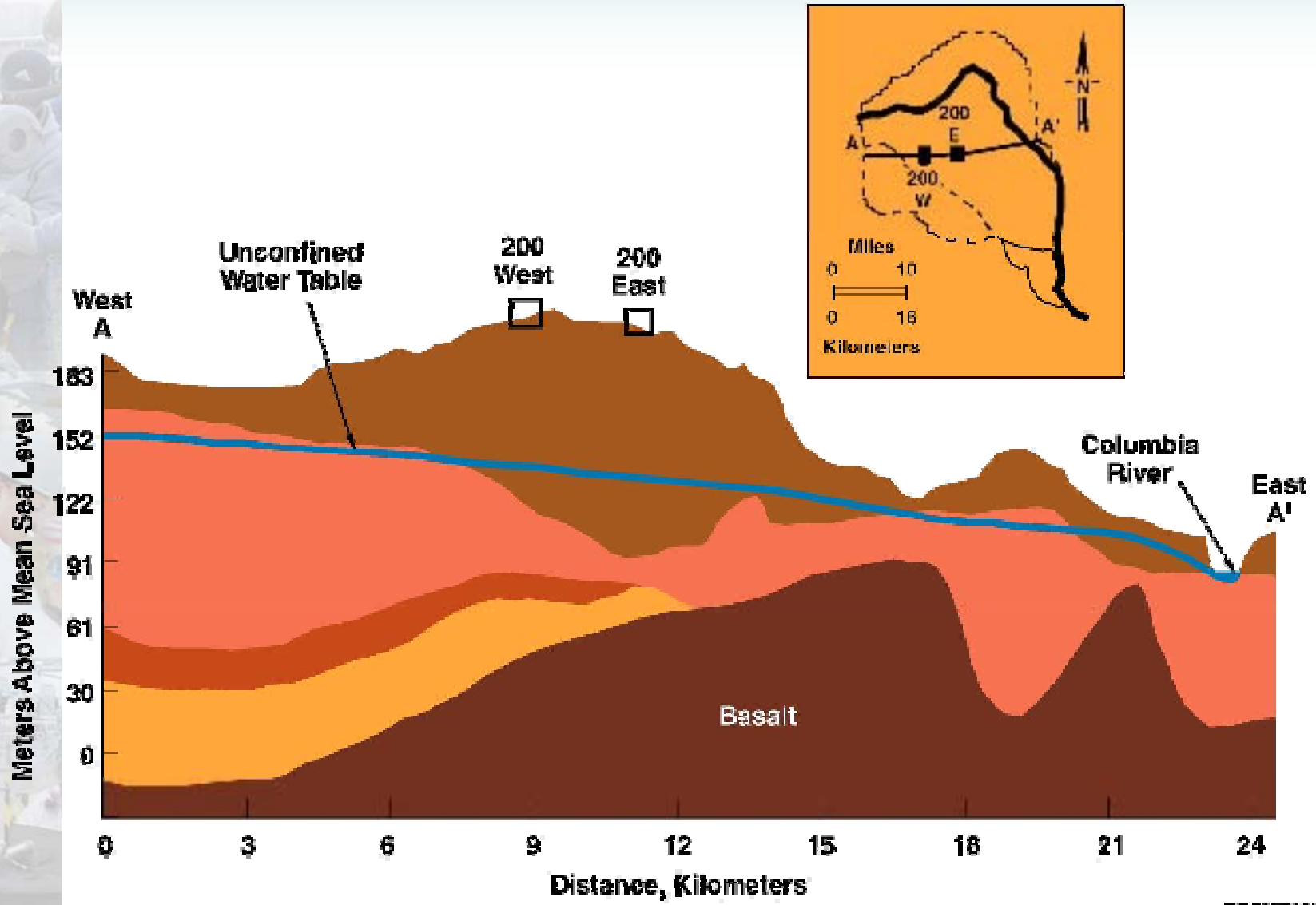
January 19, 2005

CH2MHILL

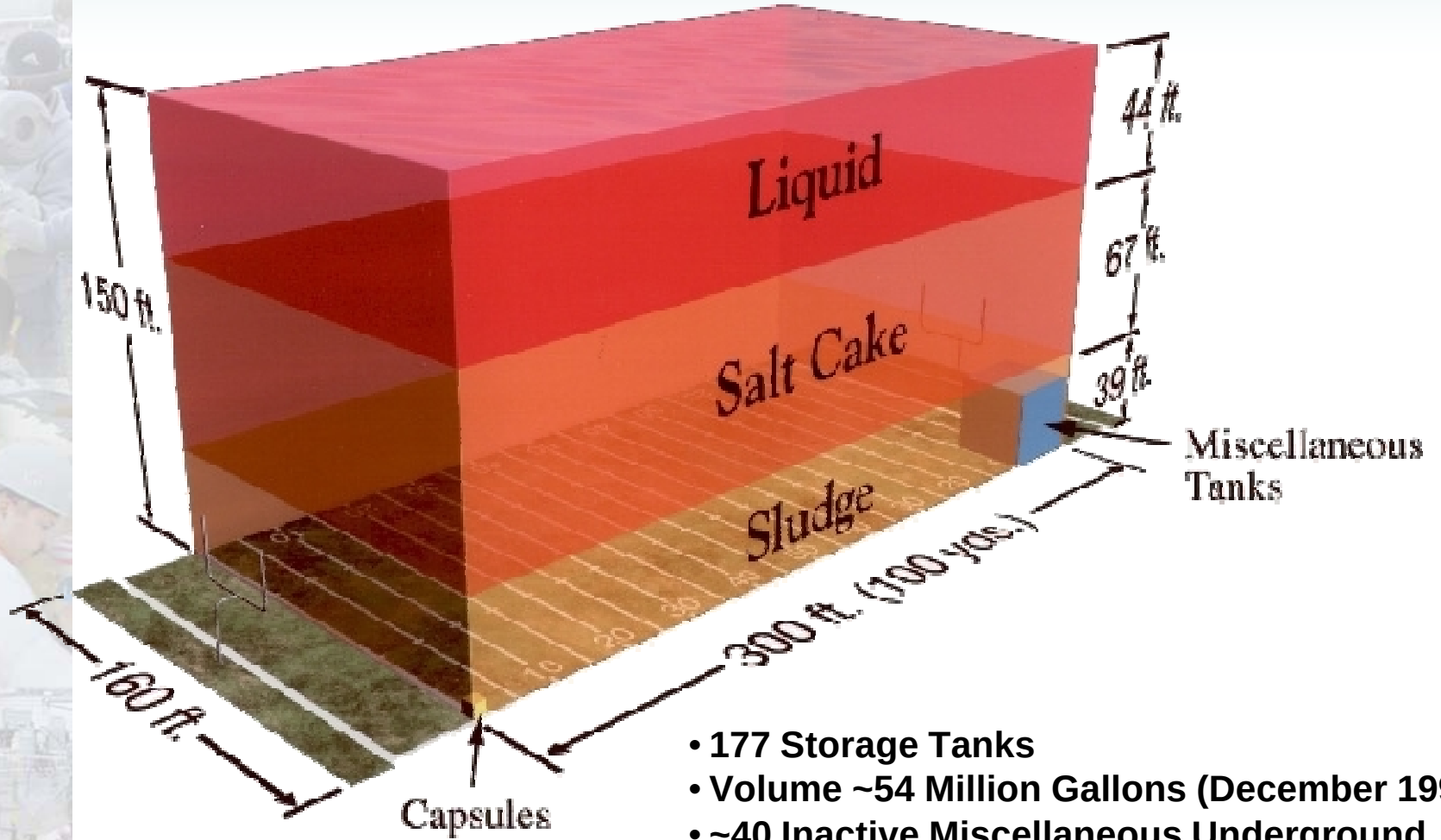
Hanford Group, Inc.


Hanford Site Location Map
D/DR
H
N
F
KW/KE
B/C
100 Areas
Columbia River
200 West Area
200 East Area
Rattlesnake Mt.
400 Area
300 Area
Washington State
Hanford Site
560 Square Miles
Boeing Animation
A95040268.1

Geologic Cross Section of the Hanford Site

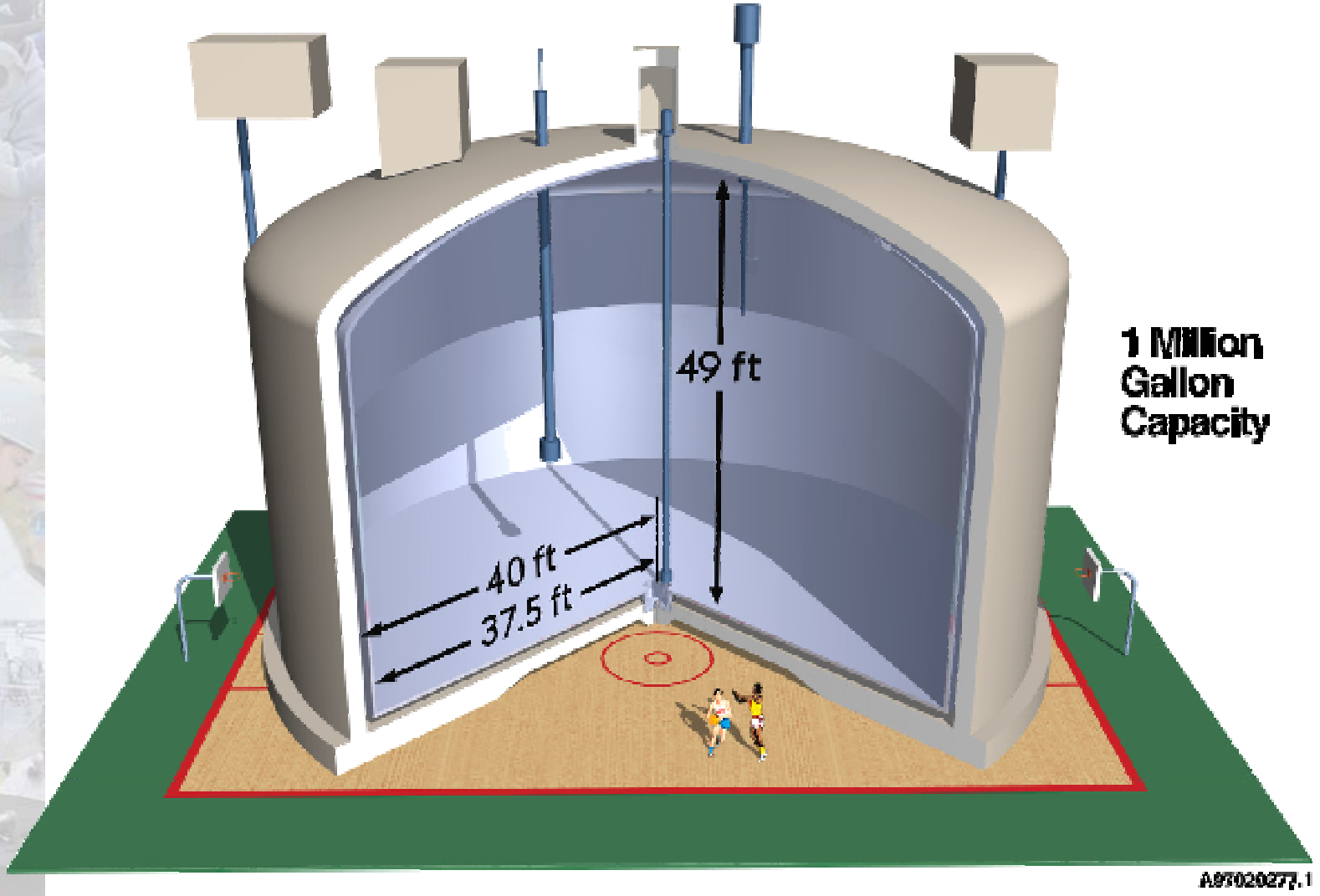


Current Hanford Tank Waste Volume

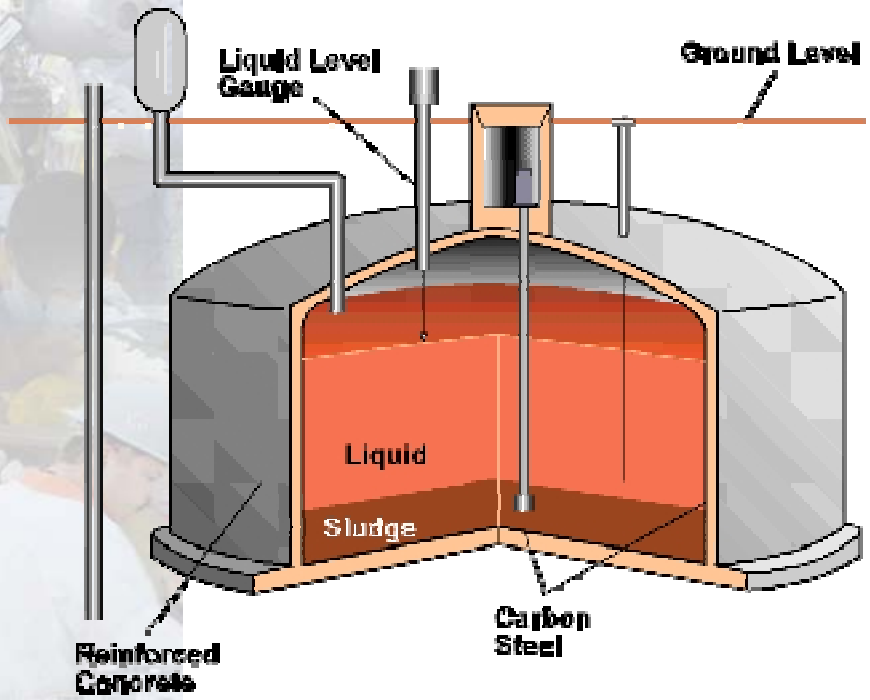


- **177 Storage Tanks**
- **Volume ~54 Million Gallons (December 1998)**
- **~40 Inactive Miscellaneous Underground Storage Tanks**
- **1933 Cs/Sr Capsules**
- **340 Million Curies of Radionuclides**

Hanford High-level Waste Radioactive Underground Storage Tanks are Large



Single-Shell Tanks



- 149 Tanks Constructed 1943-64
- ~210 m^3 to 3,800 m^3 Capacity (55 kgal to 1 Mgal)
- Bottom of Tanks at Least 50 m (150 Feet) Above Groundwater
- No Waste Added to Tanks Since 1980
- Tanks Currently Contain:

  ~132,500 m^3 (35 Mgal) of Salt Cake, Sludge, and Liquid

  ~407 x 10^{16} Bq (110 MCi)
- 67 Are Assumed to Have Leaked ~ 3,800 m^3 (~1 Mgal)

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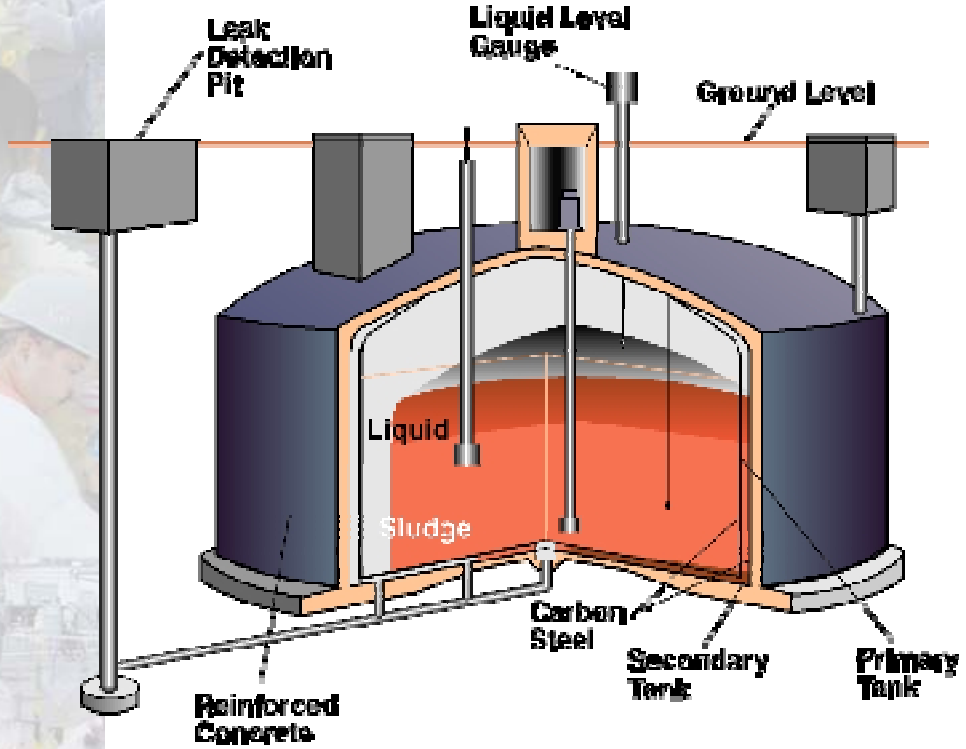
Rev. Date 3/16/07

CHG00501-11

Inside Tank SX-109

Double-Shell Tanks

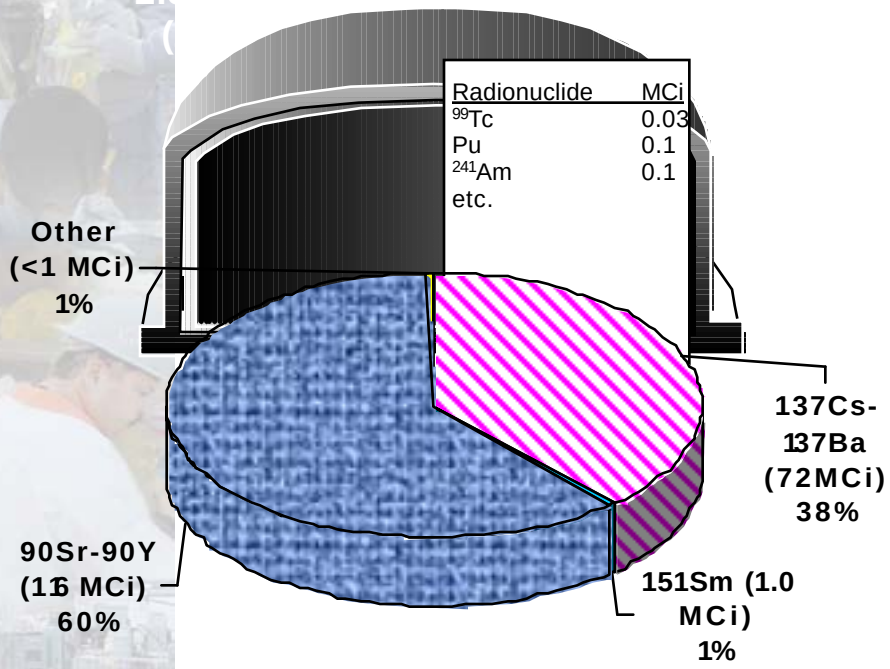


- 28 Tanks Constructed Between 1968-86
- ~3,800 m^3 to 4,300 m^3 (1 to 1.14 Mgal) Capacity
- Tanks Currently Contain
  - ~ 72,000 m^3 (19 Mgal) of Mostly Liquids (Also Sludges and Salts)
  - ~ 296 x 10^{16} Bq (80 MCi)
- None Have Leaked

AP Tank Farm

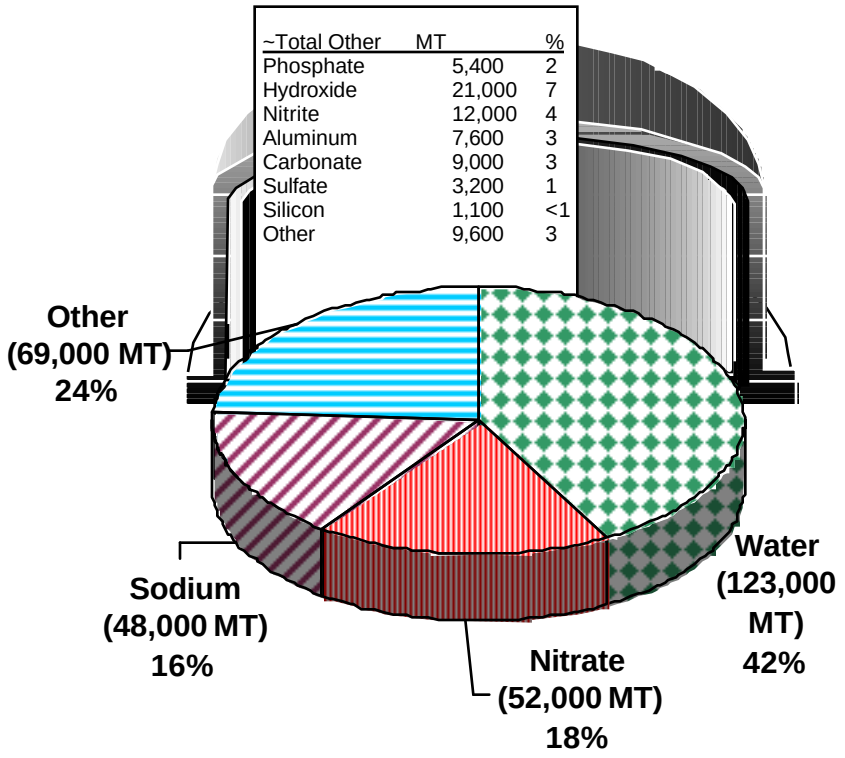
Hanford Site Waste Tanks Estimated Inventories

Radionuclide Inventory Decayed to 12/31/96*



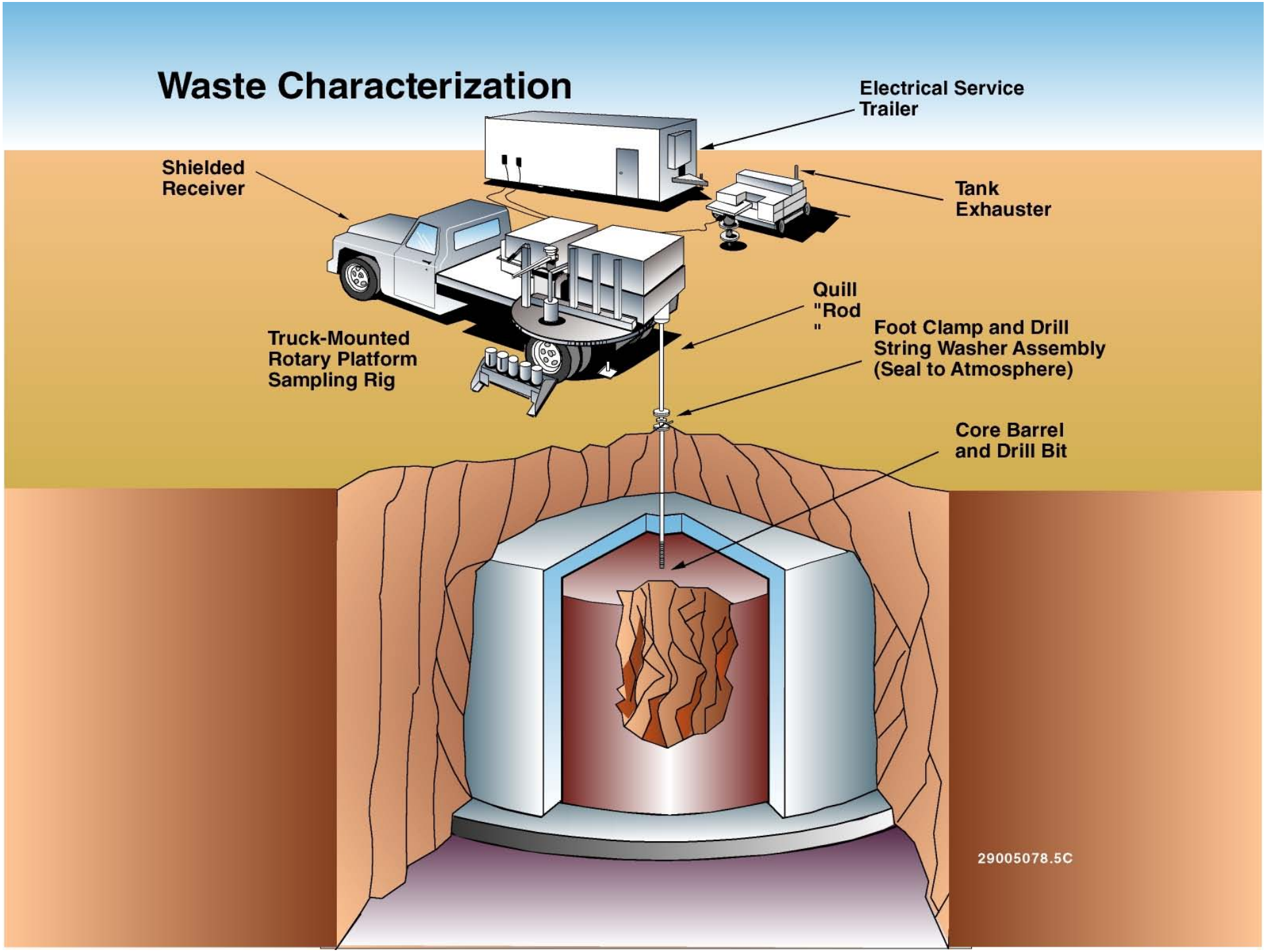
Total in All Tanks
190 MCi

Chemical Inventory**



Total in All Tanks
292,000 Metric Tons

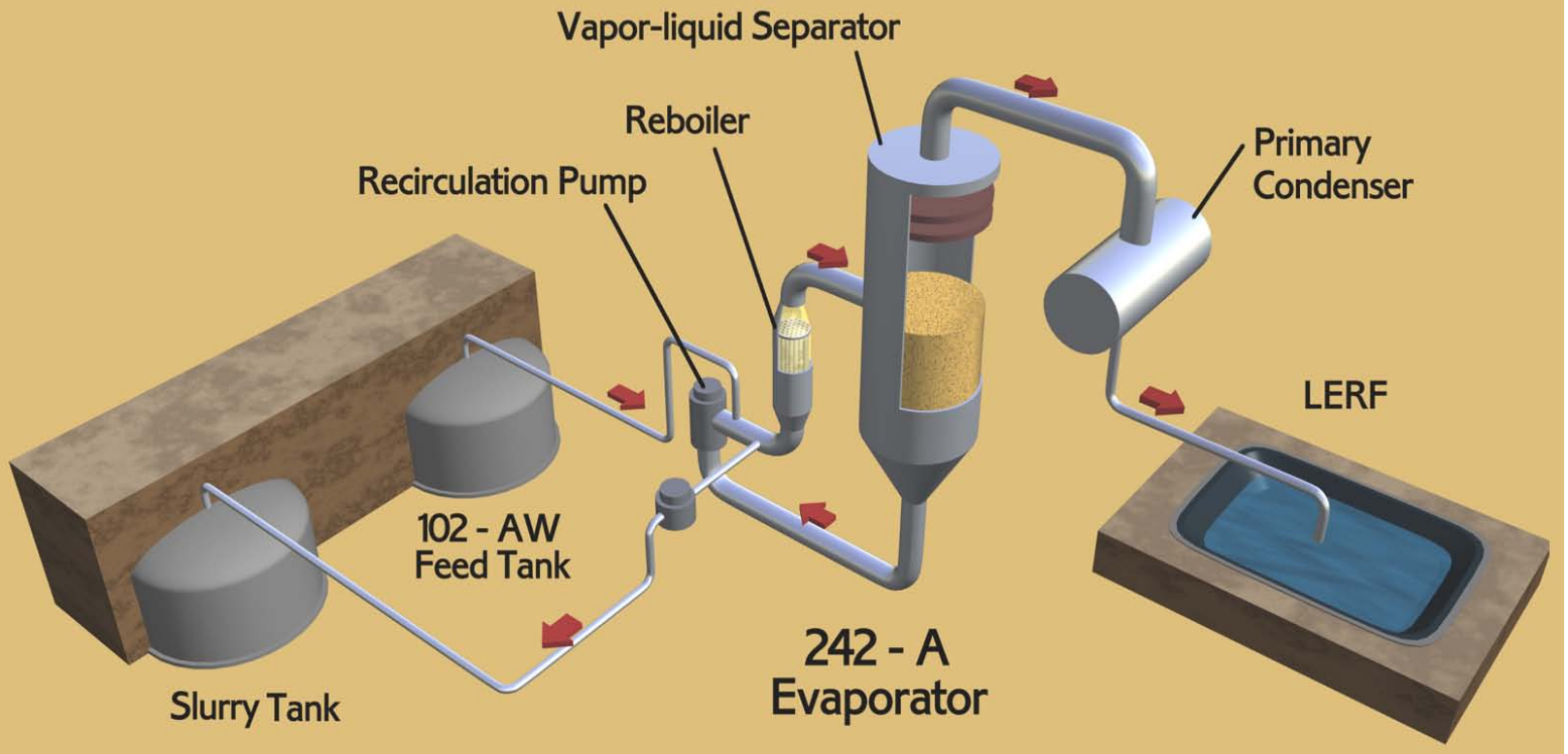
**Data Source:* DOE/RW-006, Rev. 13 1996 Integrated Data Base
**Tank Characterization Database, 9/97


Waste Characterization
Electrical Service Trailer
Shielded Receiver
Tank Exhauster
Quill "Rod "
Truck-Mounted Rotary Platform Sampling Rig
Foot Clamp and Drill String Washer Assembly (Seal to Atmosphere)
Core Barrel and Drill Bit
29005078.5C

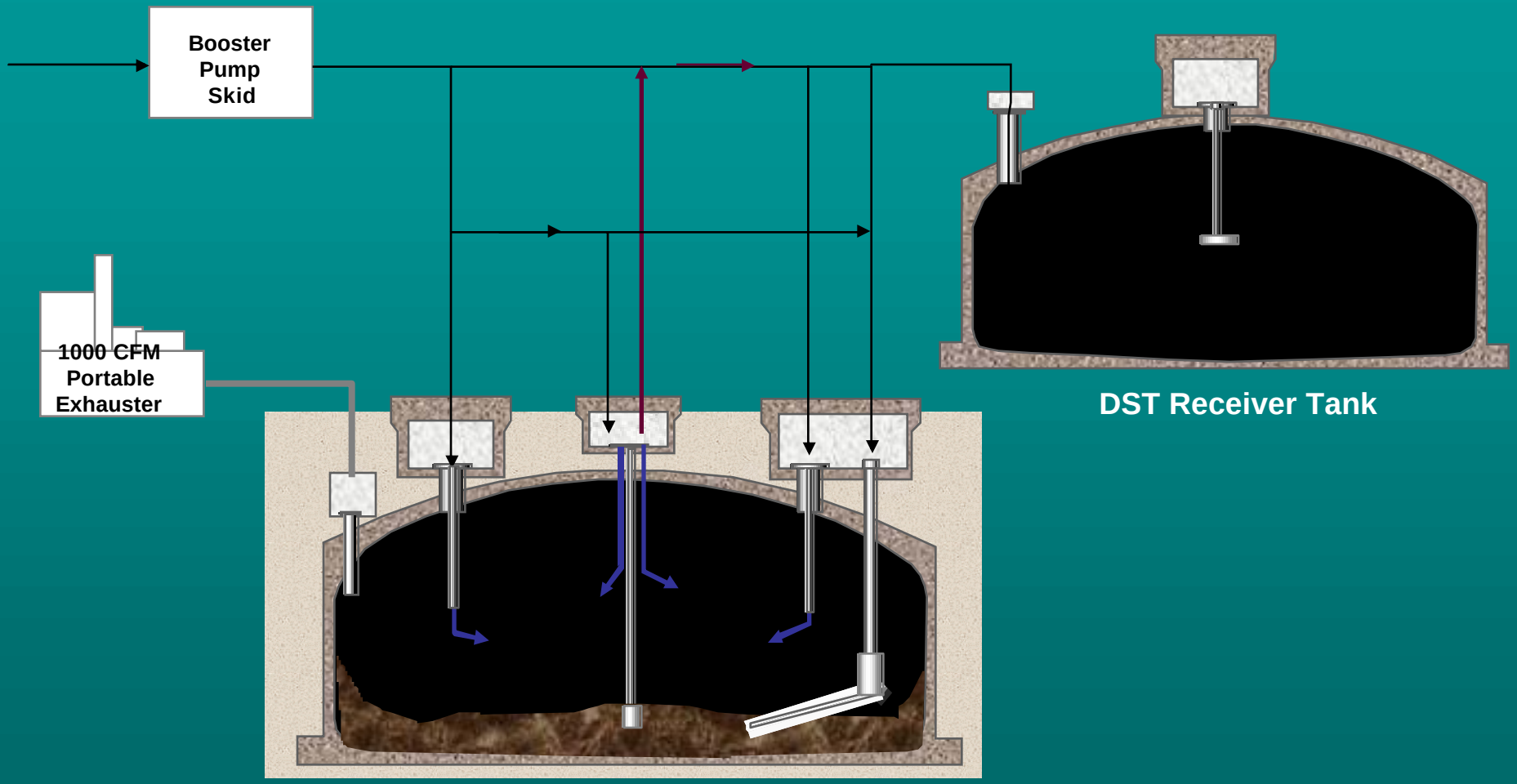
Core Sampling Tank BY-110

242-A Evaporator

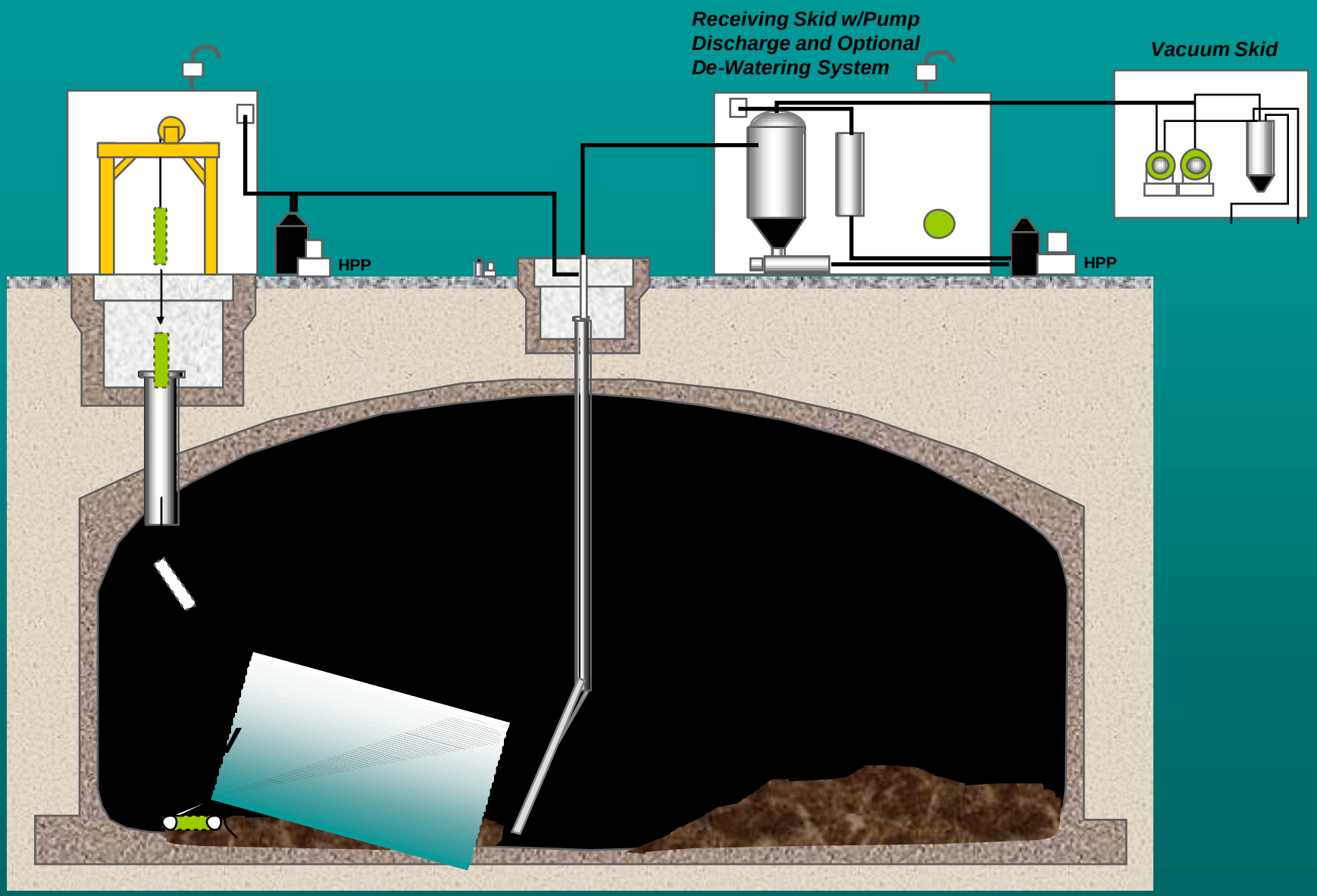
242 - A Evaporator Crystallizer Flow Sheet



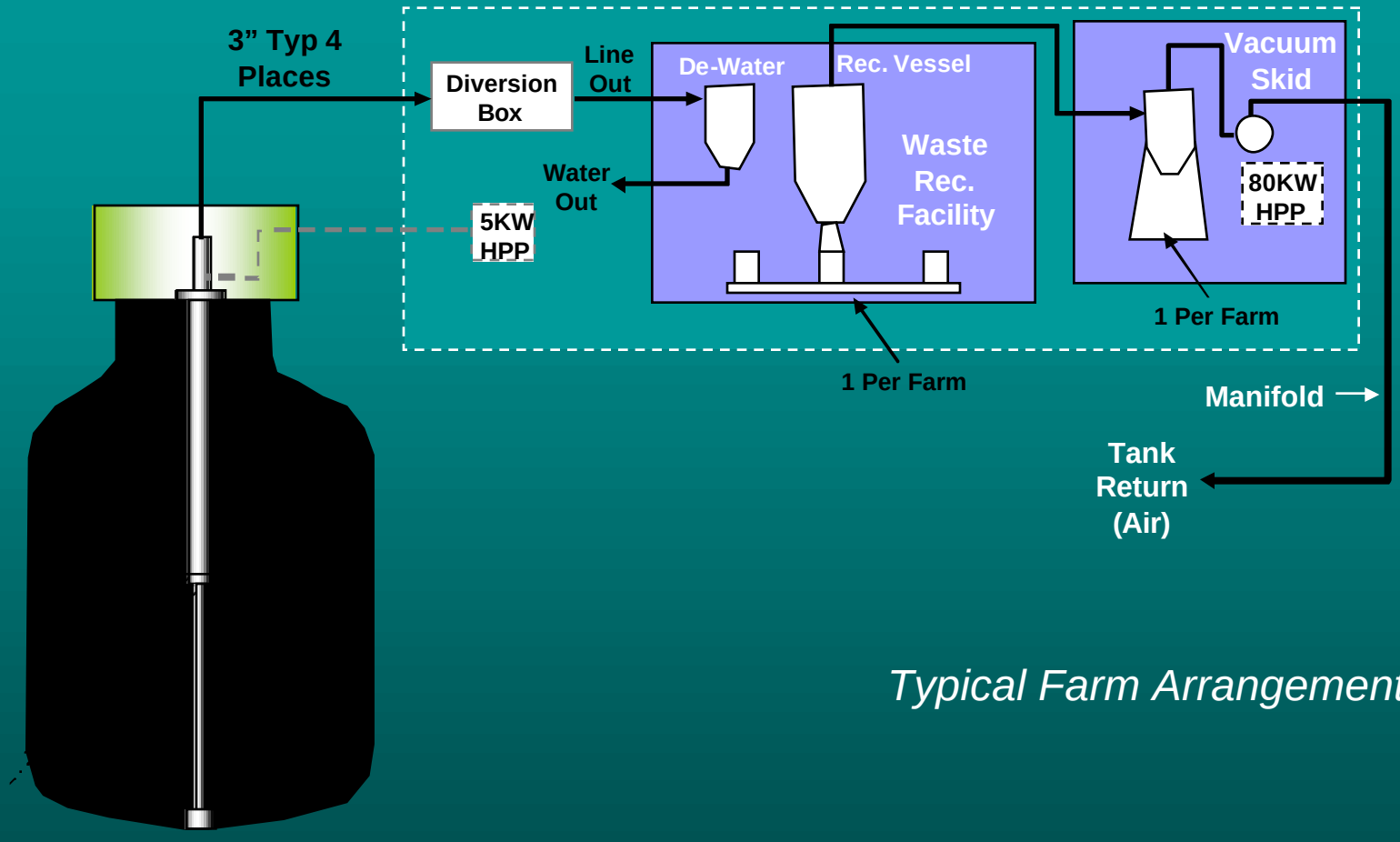
Typical Modified Sluicing Approach



Typical Mobile Retrieval System (MRS)



Typical Vacuum Retrieval System

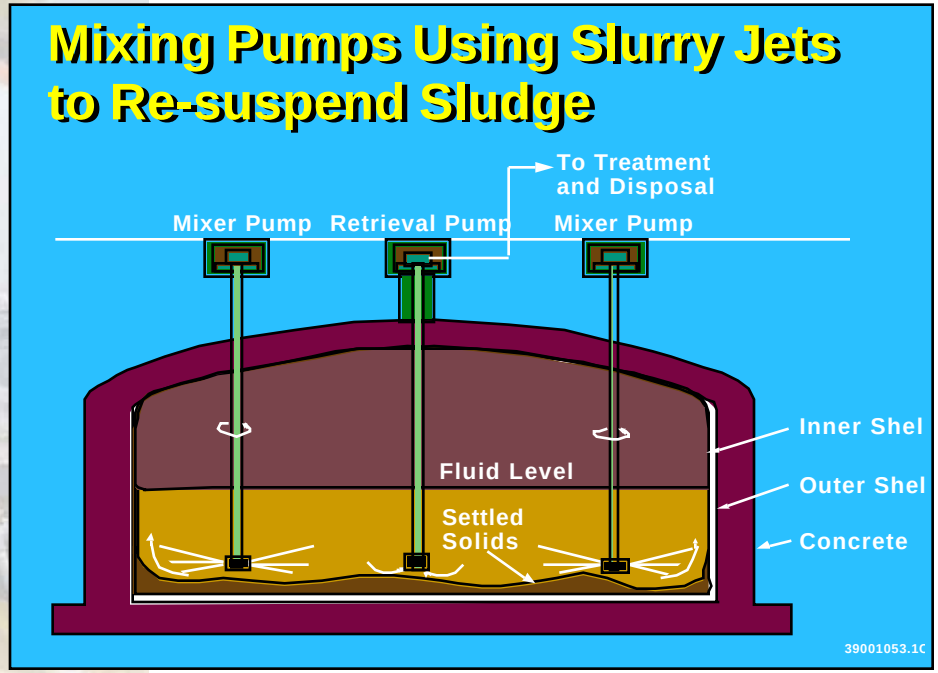


Typical Farm Arrangement

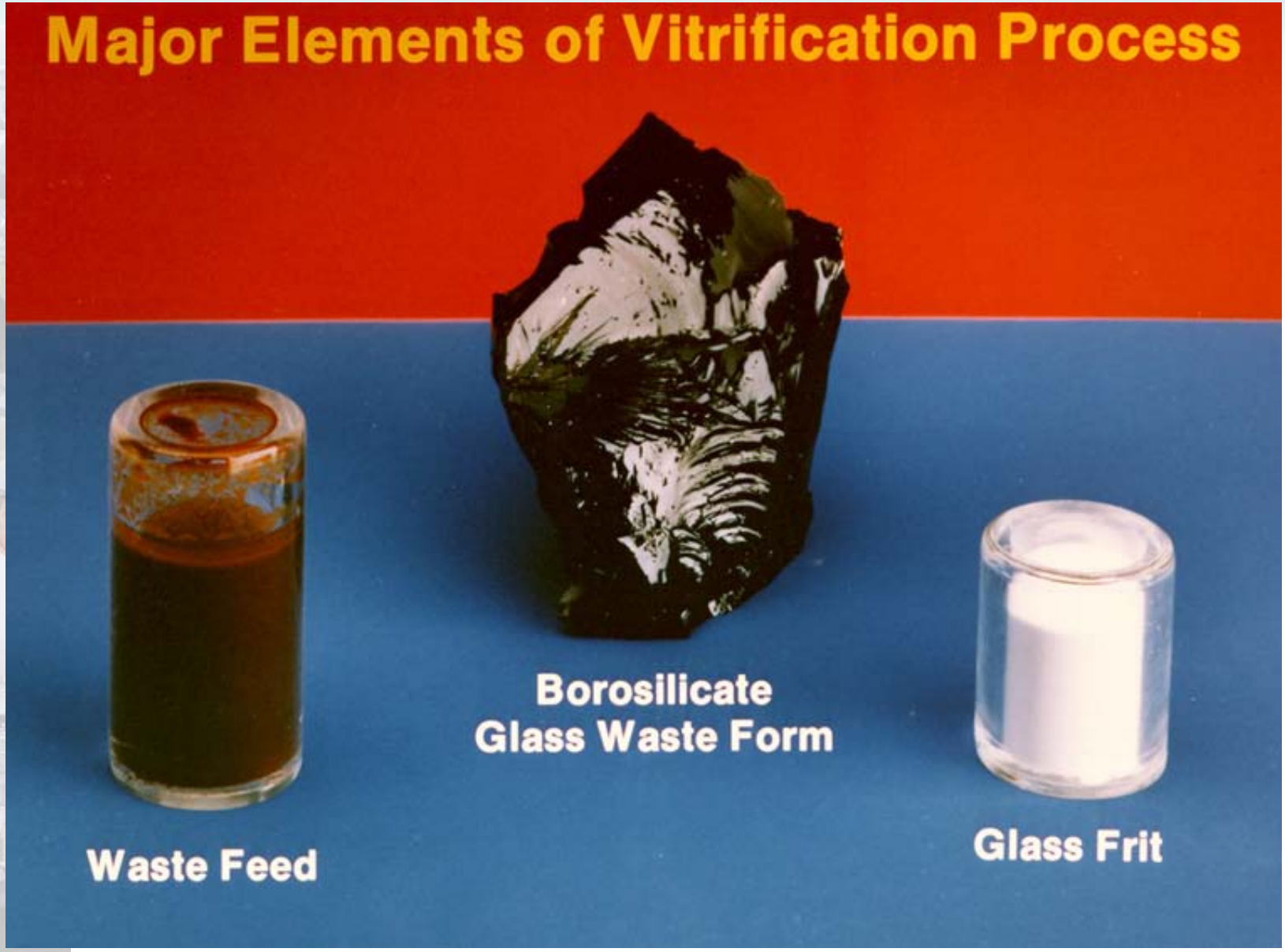

Newly constructed Cold Test Facility

DST Mixer Pump Retrieval System

- 101-AZ Demonstration mobilized the bottom sludge layer with two 300 hp mixer pumps



Major Elements of Vitrification Process



Containerized Grout

Typical containerized grout in 55-gallon drum

Example mobile facility for grouting LAW

Example fixed facility for grouting LAW

- Most commonly used LAW disposal method in U.S. and world wide
- Salt waste would be immobilized in grout within a container prior to disposal
- Could be deployed using feed from the pre-treatment plant or separately using feed from retrieval
- Waste form performance requires additional evaluation
- Could be sized to meet wide range of treatment capacity needs

Bulk Vitrification

- Waste mixture staged in insulated box
- Hood and electrodes installed
- Wastes treated
- Melt allowed to cool and solidify
- Hood removed, lid installed
- Box transported to disposal site

Bulk vitrification in a 20 cubic yard roll-off box (off-gas processing hood not shown)

- Waste is vitrified into a borosilicate glass in a disposable container
- Could be deployed using feed from the pre-treatment plant or separately using feed from retrieval
- Waste form performance requires additional evaluation
- Could be sized to meet wide range of treatment capacity needs

Science and Technology Needs to Support Hanford Tank Farms (1 of 13)

- **Tank farm based aluminum leaching/caustic washing**
  - In-tank monitoring tools
  - Balance of mission tanks characterization,
  - Al equilibrium and kinetics
  - Flow sheet engineering modeling
  - Flow sheet validation/pilot testing
  - Caustic recycle technology

Science and Technology Needs to Support Hanford Tank Farms (2 of 13)

- **Improved Retrieval Methods**
  - Dissolution Retrieval (especially handling phosphate)
  - Improved sluicing retrieval
  - Heels retrieval
  - Tank waste modeling

Science and Technology Needs to Support Hanford Tank Farms (3 of 13)

- **Tank Residuals Inventory**
  - Residuals Volume measurement
  - Residuals characterization

Science and Technology Needs to Support Hanford Tank Farms (4 of 13)

- **Tank Residuals Long-term Immobilization**
- **Materials to immobilize contaminants of concern (Tc, I, Se, U, Cr)**
- **Tests methods to predict long-term performance data for materials**
- **Methods to add, distribute, and mix immobilization materials**
- **Characterize interface boundary region between immobilization material and residue (e.g. strength, behavior as blended phase or two phases, contaminant release)**

Science and Technology Needs to Support Hanford Tank Farms (5 of 13)

- **Industrial Hygiene—Monitoring and Mitigation of Tank Vapors**
  - Improved monitoring systems: low detection limit (high parts per trillion) in the air workspace environment of potentially hazardous organic, ammonia and water vapor mixtures
  - Low flow detection (e.g. ft^3/hr or ft^3/day) in passive ventilation systems with industrial, outdoor environment
  - Mitigation methods to reduce exposure for mixtures of ammonia, organics, and water vapors

Science and Technology Needs to Support Hanford Tank Farms (6 of 13)

- **Industrial Hygiene—Monitoring and Mitigation of Tank Vapors (Continued)**
  - Mixtures of chemicals, some odor causing, some not; If many are below the odor threshold, would workers smell something with the mixture? Where is such work reported?
  - Toxicologies of dilute, complex mixtures of hundreds of compounds. What should be the process for assigning Occupational Exposure Limit (OEL)? Does the sum of fractions work? Are there synergy, antagonism, or facilitation enabling effects?
  - Contact: James_O_Jim_Honeyman@rl.gov

Science and Technology Needs to Support Hanford Tank Farms (7 of 13)

- **Tank Residuals Release Mitigation**
  - Long-term Surface Barriers
  - Subsurface getter materials

Science and Technology Needs to Support Hanford Tank Farms (8 of 13)

- **Bulk Vitrification Enhancements**
  - Increased waste loading
  - sulfate tolerance
  - reduce cycle time
  - Increased waste volume/box

Science and Technology Needs to Support Hanford Tank Farms (9 of 13)

- **Develop technical basis to establish engineering standards for pumping slurries**
  - Sludge waste particle character (size distributions, density, etc.)
  - Salt cake waste particle character (size distributions, density, etc.)
  - Viscoelastic behavior of sludge or salt cake slurries

Science and Technology Needs to Support Tank Farms (10 of 13)

- **Dissolution of lesser soluble tank constituents and residues**
- **Pipe Plugging/Unplugging—qualify "toolbox" of technologies for rapid deployment when/if need arises.**
- **In-Line monitoring of retrieved waste composition**
- **In-line process monitoring (melter feed control)**

Science and Technology Needs to Support Tank Farms (11 of 13)

- **Inspection of Tank Risers—simple rapid measurement of riser dimensions and "trueness" to facilitate equipment design and deployment. (Existing risers are 2-42 inch diameter by a few feet deep)**
- **Tank domes—inspection tools to verify structural and containment integrity of tank domes.**

Science and Technology Needs to Support Tank Farms (12 of 13)

- **Salt Cake Chemistry**
- **Thermodynamic equilibrium chemistry modeling; kinetics of dissolution modeling**
- **Development of modeling database for Hanford unique conditions**
- **Modeling of flow sheet options**
- **Lab/pilot demonstration of flow sheet processes**

Science and Technology Needs to Support Tank Farms (13 of 13)

- **Tank Corrosion Chemistry—Determine impacts on corrosion of temperature, pH, ionic strength, and composition in areas within and outside of current tank specifications.**

Environmental Excellence
HANFORD

CHG00501-11